Mathematics Department
Brooklyn College, City University of New York
Math 4201 (Advanced Calculus 1)
4 hours, 4 credits

Suggested Textbooks:
- Introduction to Analysis, by Maxwell Rosenlicht
- Analysis, by Steven Lay
- Elementary Analysis: The Theory of Calculus, by Kenneth Ross

1. Real numbers:
   - Real numbers as an ordered field.
   - The axiom of completeness, supremum and infimum.
   - Metric spaces. (optional)
   - Open and closed sets; Convergent sequences; Completeness, compactness, and connectedness.
   - The completeness of the set of real numbers, Bolzano–Weierstrass and Heine–Borel Theorems for the set of real numbers.
   - Connected subsets of the set of real numbers.

2. Continuous functions on metric spaces:
   - Definition.
   - Continuity and limits.
   - The continuity of rational operations.
   - Continuous functions on compact and on connected spaces.
   - Uniform continuity.
   - The maximum value theorem and the intermediate value theorem for the set of real numbers.
   - Sequences of functions, uniform convergence.
   - Limit superior and limit inferior in the set of real numbers. (optional)

3. Differentiation:
   - Definition of derivative.
   - Differentiability and continuity.
   - Rules of differentiation.
   - The mean value theorem.
   - Taylor's theorem.
   - The Cauchy mean-value theorem. (optional)
   - l'Hospital's rule. (optional)

4. Riemann integration:
   - Definition and examples.
   - Linearity and order properties.
   - Existence.
   - The fundamental theorem of calculus.
   - Change of variables.
   - Integration by parts. (optional)
   - The logarithmic and exponential functions. (optional)

5. Interchange of limit operations:
   - Integration and differentiation of sequences of functions.
   - Infinite series; Cauchy convergence criterion; ratio test; alternating series; rearrangement and grouping of absolutely convergent series; Weierstrass test for function series.
   - Power series.
   - Differentiation under the integral sign. (optional)
   - The trigonometric functions. (optional)